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CA 2322916 A1 2002/04/06

(21) 2 322 916

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2000/10/06

(41) Mise à la disp. pub./Open to Public Insp.: 2002/04/06

(51) Cl.Int.^{7}/Int.Cl.^{7} E21B 7/02

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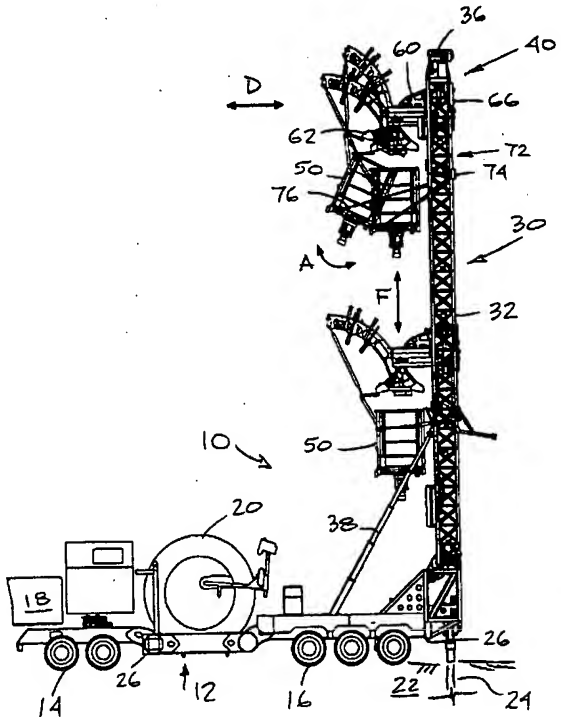
(54) Titre : SYSTEME INJECTEUR PIVOTANT
(54) Title: PIVOTING INJECTOR ARRANGEMENT



(57) Abrégé/Abstract:
An injector arrangement for use in a rig has a movable carrier, a derrick tiltably mounted to the carrier, and a trolley capable of sliding along the derrick. An injector cradle is movable along the trolley in at least a plane perpendicular to the derrick and is pivotally mounted beneath the trolley. An injector is supported at its upper end from the cradle. At least two hydraulic cylinders are supported at one end by the derrick and are engaged at an opposed end to a lower end of the injector for rotating and tilting the injector relative to the trolley and derrick.

TEM File No. 173.5

TITLE: PIVOTING INJECTOR ARRANGEMENT

FIELD OF THE INVENTION

The present invention relates to drilling and servicing equipment for oil and gas wells generally, and in particular relates to an arrangement for multi-dimensional pivoting of an injector for use in rigs which transport and/or operate equipment for continuous coiled tubing drilling, for conventional joined pipe handling and drilling, and/or for wireline applications.

BACKGROUND OF THE INVENTION

Applicant's United States Patent 6,003,598 and corresponding Canadian Patent 2,235,555 for a "Mobile Multi-Function Rig" disclose an injector carried by a cradle which is movable in two planes, namely in both generally vertical and horizontal planes, when the derrick is in an upright operating mode. Such movement helps align an injector over a wellhead. Should the wellbore be inclined, such as in a "slant well", then the orientation of the injector must be further adjusted by slanting the derrick accordingly in one vertical plane and, if need be, the rig's chassis stabilizers can be manipulated somewhat to provide tilt in a second vertical plane. In an exceptional case where the range of adjustment of the rig's equipment is insufficient for proper alignment, the rig itself may have to be moved and parked again in a different approach to the well. Although such manipulation provides an advantageous three dimensional ("3-D") maneuvering capability to the injector, the procedure is somewhat cumbersome and time consuming.

Other conventional derricks, particularly those used on mobile carriers, are more restricted in their ability to line up with and service slant wells. What is desired therefore is a novel injector cradle or trolley arrangement for use in rigs, particularly multi-task rigs which transport and/or operate equipment for oil and gas operations. The arrangement should allow accurate alignment of the injector with a well, such as a slant well, to reduce or avoid the need to either tilt the mast or move the carrier to achieve a desired alignment with the well. In particular, the novel arrangement should allow the injector to be moved laterally in two directions relative to the derrick, generally vertically along the derrick, and to tilt and rotate relative to the derrick, so as have up to 6 degrees of freedom relative to the well, exclusive of any inclining of the derrick or movement of the rig itself.

SUMMARY OF THE PRESENT INVENTION

According to the present invention, there is provided in one aspect an injector arrangement for use in a rig comprising a mobile carrier, a derrick pivotally mounted to the carrier, a trolley capable of sliding along the derrick, an injector cradle movable along the trolley in at least a plane perpendicular to the derrick and having an upper end pivotally mounted beneath the trolley, an injector supported by the injector cradle, and at least two hydraulic cylinders supported at one end by the derrick and engaged at an opposed end to a lower end of the injector for rotating and tilting the injector relative to the trolley and derrick.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a side view of a mobile multi-function rig which employs a trolley and cradle for supporting and manipulating an injector according to a preferred embodiment of the present invention showing two selected vertical locations of the injector when moved laterally out of the plane of the rig's derrick, and one view of the injector in a tilted position;

Figure 2 is an end view of the derrick of fig. 1; and,

Figure 3 is a close-up perspective view of the trolley, cradle and injector arrangement of the present invention.

LIST OF REFERENCE NUMBERS IN DRAWINGS

10	mobile rig
12	carrier
14	front end of 12
16	rear end of 12
18	cab
20	cartridge assembly
22	ground surface
24	well
26	stabilizers
30	derrick
32	masts (2)

36	crown
38	hydraulic legs
40	winch assembly
50	injector
52	axis
54	cage of 50
56	point on injector
60	trolley
62	cradle
63	ball connection of 62 to 60
64	chimney of 60
66	c-shaped channel
68	tracks (first)
70	second track
72	brace arms
74	guide member
76	tilt cylinder(s)
78	first end of 76
80	second end of 76

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows a mobile rig 10 for transporting drilling and servicing equipment to an oil or gas well site. The equipment, such as a cartridge assembly 20 capable of holding various sizes of continuous or coiled tubing ("CT") reels, is located aboard a self-propelled carrier 12 having a tandem axle front end 14 and a triple axle rear end 16. A cab 18 houses an engine for driving the front and/or rear axles, and incorporates conventional controls for steering the carrier over a ground surface 22 and for locating the carrier's rear end over a well. The term "well" is understood herein to mean either an oil or gas well to be drilled, or an existing well or wellhead 24 which is to be tested or serviced. The carrier 12 incorporates a number of hydraulically operated stabilizers 26 for lifting the carrier off the ground and enhancing lateral stability during well operations. The front and rear axle designs may vary depending on the anticipated weight of equipment to be carried and the type of terrain to be encountered. The carrier's design is generally symmetrical about its longitudinal axis.

The rig 10 includes a number of drilling and servicing features aboard the mobile carrier 12, including a derrick 30 pivotally mounted to the rear of the carrier. The derrick is capable of supporting a blow out preventer ("BOP") and an injector 50 for moving CT into and out of the well. The derrick incorporates a winch arrangement 40 to perform multiple tasks, such as raising and lowering the injector and a lubricator along the derrick, as well as running joined pipe segments. The derrick 30 has two longitudinally spaced mast members 32 (see fig.2), each formed by a triangular (in cross-section) truss arrangement. A telescoping hydraulic cylinder or leg 38 is attached to each mast to tilt the derrick 30 between a transportation mode and an operating mode, as set out in more detail in applicant's US Patent 6,003,598. The masts 32 are joined at the top end by a crown 36

housing a pair of conventional pulley wheels, or "sheaves", which carry steel cables and a traveling block of the winch assembly. The traveling block fits from below into a chimney element 64 extending upwardly from the injector's trolley 60 (fig.3) so that the winch assembly can slide the trolley and injector generally vertically along the elevated masts 32 to any desired location, two of which are shown in figs.1&2. The traveling block may also be used independently of the injector for performing other tasks, such as moving joined pipe sections, by first locking the injector trolley 60 at the top of the derrick and parking the injector out of the plane of the derrick, as seen in fig.1.

Referring now more specifically to fig.3, a pair of c-shaped channel members 66, one on either side of the generally symmetrical trolley 60, engage and ride on the masts 32 as the trolley is lifted or lowered by the earlier described winch mechanism. The trolley has a first set of tracks 68 for moving the cradle 62, which supports the injector 50 from above, laterally out of the plane of the derrick via a screw mechanism. In the embodiment shown, the tracks 68 provide up to 54 inches (about 1372mm) of lateral movement, and the trolley is capable of traveling along the derrick whether the injector is located within the derrick or is "parked" laterally out of the plane of the derrick. A second track 70 located beneath and perpendicular to the first set of tracks 68 allows the cradle to move generally horizontally and parallel to the plane of the derrick via a side-to-side cylinder. In the embodiment shown, the cradle may be moved up to 6 inches (about 152mm) to either side of centre.

An upper portion of the cradle 62 is supported beneath the trolley 60 via a ball-like connection 63 to allow the cradle and injector to be pivoted relative to the trolley and derrick by a novel injector pivoting arrangement of the present invention. A brace, namely a pair of brace arms 72, extends downwardly from each channel 66 to a c-shaped guide

member 74 which is located in-line with the channel 66 to ride along a respective mast 32. A hydraulic tilt cylinder or ram 76 is connected at a first end 78 to the guide member 74 and at an opposed second end 80 to the injector 50. In the preferred embodiment the cylinder's second end 80 is connected to a lower portion of a protective cage 54 of the injector 50, at a point generally furthest from the derrick for easier tilting and rotating of the injector (i.e. cantilever effect). Another acceptable location may be at a point 56 on a lower platform of the injector. Each cylinder 76 is capable of being controlled independently of the other.

Some of the movement made available by the present arrangement should now be better understood. If both tilt cylinders 76 are extended or retracted a like amount, the injector is tilted relative to the trolley away or toward the derrick as indicated by arrow A in fig.1. If one cylinder 76 is extended and the other retracted a like amount, then the injector is rotated a limited amount about an axis 52 as indicated by arrow B (fig.3). If one cylinder is not activated and the other is either retracted or extended, then a combination of movements A and B results in a pivoting-like motion generally indicated by arrow C (fig.2). In addition, the cradle 62 is capable of moving the injector in and out of the derrick, and side-to-side relative to the derrick, as indicated by arrows D and E, respectively. As noted earlier, the trolley 60 supporting the cradle is movable along the derrick as indicated by arrow F. Hence, the injector 50 has up to 6 degrees of freedom, or movement, relative to a wellhead for proper alignment, excluding the tiltability of the derrick with the legs 38 and the movement of the carrier 12 itself relative to the well.

An example of a typical rig operation may now be outlined for aligning the injector with a well, with the aid of the preferred embodiment of the pivoting injector arrangement of the present invention. The rear end of the carrier 12 is first backed up over the well,

and the derrick is inclined roughly parallel to the well via legs 38. The trolley 60 is brought (i.e. is elevated or lowered in the direction of arrow F) to a desired height along the derrick. Once these preliminary or "rough" alignments are completed, then "finer" adjustments of the injector 50 are made by moving the injector cradle 62 along the track 70 (in the direction of arrow E) and, if necessary, along the tracks 68 (in the direction of arrow D) to bring the injector into closer alignment with the well. If need be, even finer adjustments may then be made of the injector orientation by manipulating the tilt cylinders 76 to move the injector in one or more of directions A, B and C. The desired orientation of the injector with the well should therefore be achieved. It will be appreciated that once the carrier is parked and the derrick is properly elevated, then the injector is aligned in any one or more of the movements A, B, C, D and E, in no particular order.

Among other advantages, the present invention eliminates the need to move major components of the rig, such as the derrick, to achieve fine adjustments of the injector relative to the well. Very small, precise movements of the derrick, and to a lesser extent of the trolley, are cumbersome and somewhat difficult or sometimes impossible to make. The present invention allows a rig operator to make crude adjustments with these larger components, then to make more precise adjustments using the cradle, and finally to easily and quickly make the fine adjustments for proper alignment with the tilt cylinders 76. This should provide considerable savings in time (and hence money) for properly aligning the injector. Proper alignment will further reduce stress and undue wear on well servicing equipment.

The above description is intended in an illustrative rather than a restrictive sense, and variations to the specific configurations described may be apparent to skilled persons in adapting the present invention to other specific applications. Such variations are

intended to form part of the present invention insofar as they are within the spirit and scope of the claims below. For instance, it may be possible to use more that two tilt cylinders to manipulate the injector, although this is not preferred due to increased equipment requirements and control complexities.

I claim:

1. An injector arrangement for use in a rig comprising:

a movable carrier;

a derrick pivotally mounted to the carrier;

a trolley capable of sliding along the derrick;

an injector cradle movable along the trolley in at least a plane perpendicular to the derrick and pivotally mounted beneath the trolley;

an injector having an upper end supported from the cradle; and,

at least two hydraulic cylinders supported at one end by the derrick and engaged at an opposed end to a lower end of the injector for rotating and tilting the injector relative to the trolley and derrick.

ABSTRACT

An injector arrangement for use in a rig has a movable carrier, a derrick tiltably mounted to the carrier, and a trolley capable of sliding along the derrick. An injector cradle is movable along the trolley in at least a plane perpendicular to the derrick and is pivotally mounted beneath the trolley. An injector is supported at its upper end from the cradle. At least two hydraulic cylinders are supported at one end by the derrick and are engaged at an opposed end to a lower end of the injector for rotating and tilting the injector relative to the trolley and derrick.

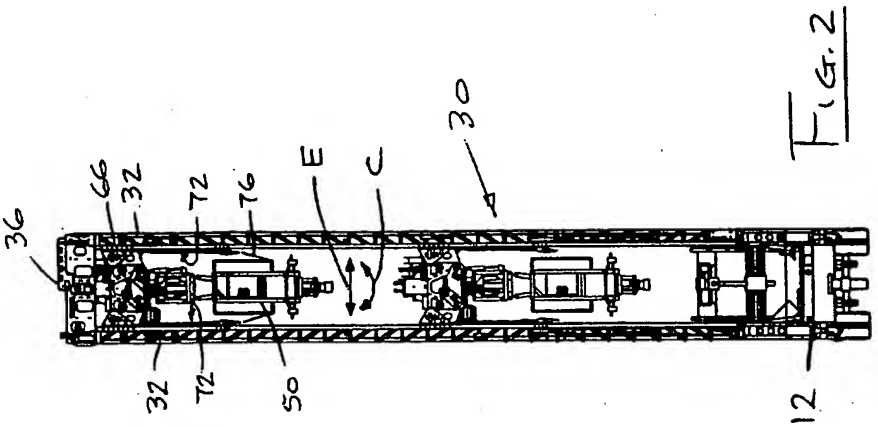


FIG. 2

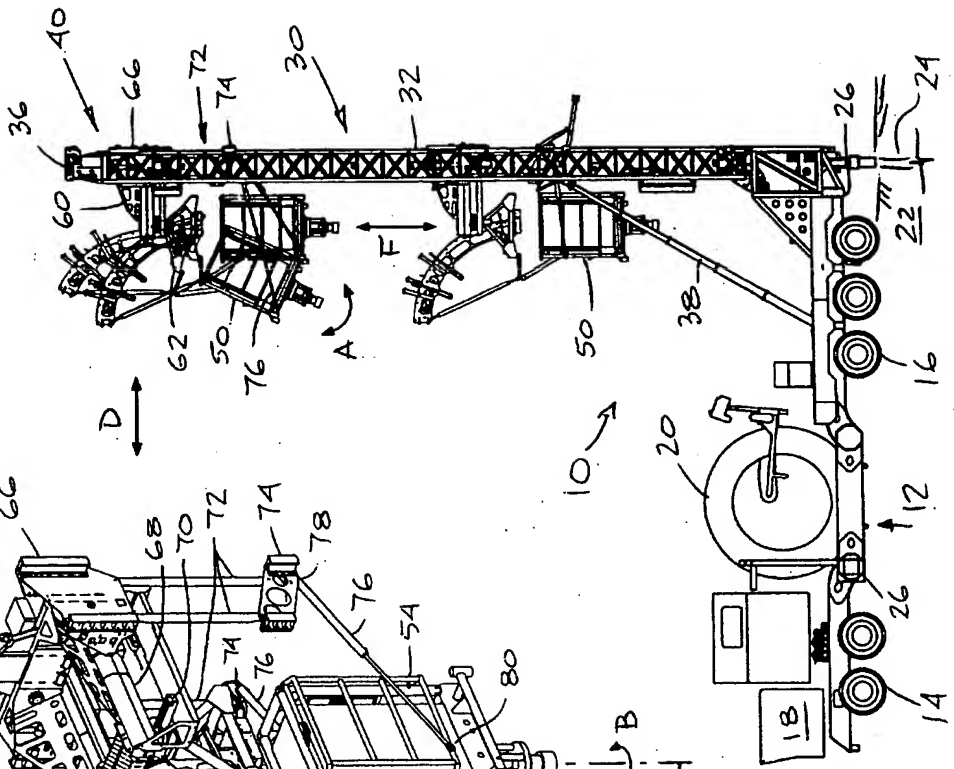


FIG. 1

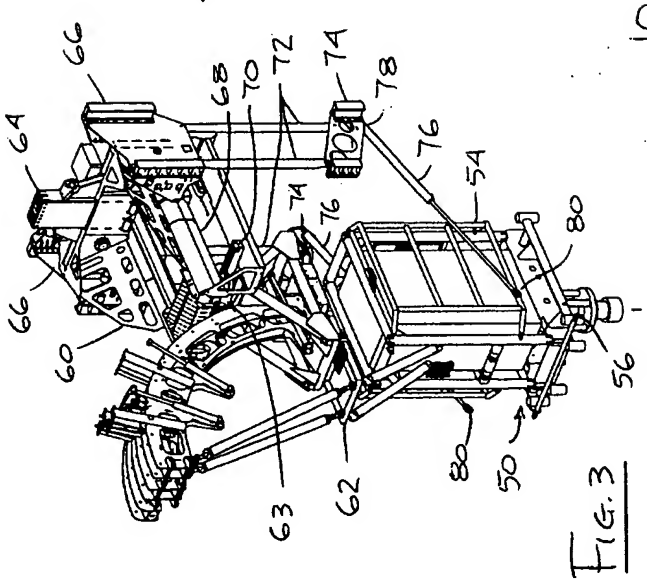


FIG. 3